Environmental Leverage INC.
Turning Liabilities into Leverage
EnvironmentalLeverage.com
1454 Louis Bork Drive
Batavia, IL 60510
Phone: 630-906-9791

Troubleshooting A Lagoon System

Lagoons come in all sizes and shapes. A lagoon can be a stabilization pond, an aerobic lagoon, High-rate aerobic pond, Low-rate aerobic pond, Maturation or tertiary pond, Facultative pond, Facultative pond with mechanical surface aeration or an anaerobic pond.

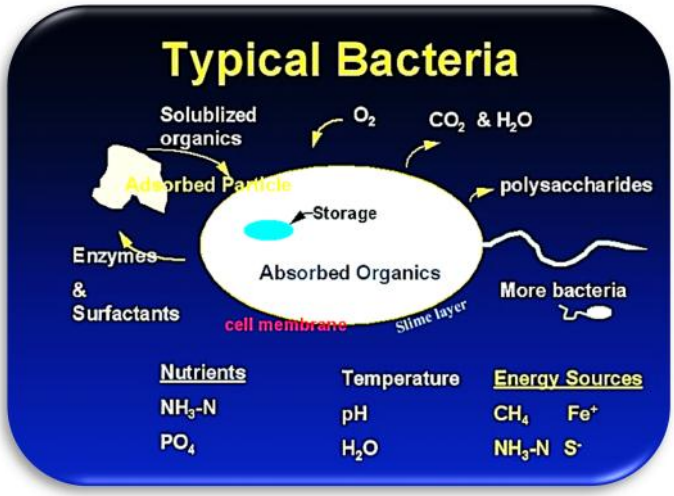
Many types of industries and municipalities use them, from refineries, animal feed lots, papermills, and chemical plants to food plants.

The benefits of a lagoon type of system are that they are easy to operate and do not require highly trained operators. They usually have very low operational cost. The disadvantages are they require large tracts of land. The hydraulic retention time is usually very long, many times 30 days minimum. There is very limited operational control. The amount of MLSS is typically in 25 to 35 mg/l range, making it harder to meet stricter permit requirements. There is poor solids removal control. Lagoons all need to be dredged at some time unless they have a clarifier after them, which is rare.

All of the above types of lagoon or pond treatment systems, except for an anaerobic pond follow the basics of traditional Secondary Biological Treatment.

All of the ponds use bacteria to degrade organics and BOD. They all usually try to meet some type of TSS permit and either have a settling zone at the back of the pond for biosolids, or in rare cases, a clarifier after the pond.

A couple of things completely different about a pond versus activated sludge: size or volume and the amount of bacteria present. Remember that biological treatment is always a time and numbers game. You typically cannot control the size since it is limited by the fixed piece of equipment or lagoon. You can only then play with the number of bacteria present in the system in order to completely handle the BOD loading. In an activated sludge system, that is controlled by the WAS or RAS. Decreasing wasting or very short term increasing return activated sludge puts back more bacteria into the front of the system. Many ponds do not have this capability. What comes in, goes out in a plug flow type of system usually.



So, what happens if you have a high BOD loading spike on your plant, are you just stuck?

No, actually many plants with lagoons systems, especially papermills in the southeast, or many food plants supplement their plants with bioaugmentation during high loading or during winter months when it is harder to achieve degradation due to the cold weather. It is easy to control, very inexpensive and usually helps with permit compliance, solids build-up in the lagoons and created a healthier environment.

All biological systems, including lagoons must pay attention to the "Critical 5"

There are 5 critical measurements that should be monitored and controlled to effectively run a biological treatment plant efficiently; Temperature, D.O., Ammonia, Ortho-phosphate and pH.

- **Acceptable environmental parameters for biological activity including:**

PARAMETER	ACCEPTABLE	OPTIMUM
Dissolved Oxygen	**>0.5 mg/l**	**1.0 - 2.0 mg/l**
Temperature	**50 - 95° F**	**77 - 95 ° F**
pH	**7.0 - 9.5**	**7.5 - 8.5**
Ammonia Residual	**1.0 - 3.0 mg/l**	**2.0 - 3.0 mg/l**
Ortho-phosphate Residual	**0.5 - 2.0 mg/l**	**1.0 - 2.0 mg/l**

***Residual should be measured in the final effluent. If additions are to be made, check influent loading though.

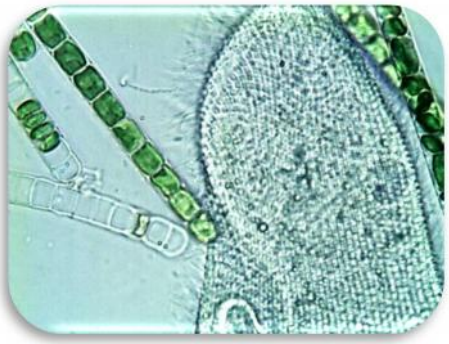
If you want more information on this, check out our Critical 5 newsletter, but if you do not control these 5 parameters in your lagoon, you will have a hard time achieving BOD and TSS removal.

Temperature is really hard to control, what can I do?

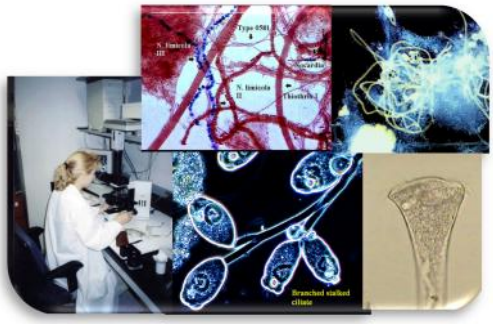
Ok, we agree, temperature is very hard to control in a lagoon. Many times in the colder months, if the lagoons are large and there is a great surface area, temperatures can significantly drop. Did you know that for every 10 degrees F◦ that the temperature drops, the bacteria lose one log's growth of activity? That can be pretty significant if you are already pressed for BOD removal. How do you get around that, many plants again supplement bacteria cultures during the winter months in order to beat that time and numbers game. It is really easy to do and works pretty well. During summer months, when the temperature increases or during the winter if the loading drops off, bacterial supplements can be decreased.

High temperature can also be a problem. BOD removal will occur, but the floc will not form as well, and many single celled bacteria or small floc may be present and high TSS can occur.

A microscopic analysis is hard to do in a lagoon? I cannot see anything in my sample?



Typically a lagoon has a significantly lower MLSS or biomass in the sample. If you are used to doing normal microscopic analyses, most standard procedures tell you to shake the sample and make sure it is completely mixed before placing a



drop of water on your slide. In a lagoon sample, there may only be a few teaspoons full or less of solids in the bottom of your jar. We sometimes do a sample two ways for a lagoon, one mixed, and one settled, and take only some of the solids on the bottom of the jar to examine. Some people even centrifuge a sample to get some solids to look at. What is really important is that you perform the analyses the exact same way every time, and then compare changes in your system in order to use it as a control and monitoring tool.

Where you sample and how it should look under the microscope are also critical.

At the beginning of the lagoon, it will be in a high growth phase so it should look the youngest. Halfway through it should be starting to stabilize and at the back end, it should be in endogenous respiration and not much activity or solids left. If you are supplementing nutrients or bacterial supplements, monitor and look at samples from the beginning and middle of the lagoon to make sure you are adding enough products to achieve the desired results.

Some plants get many higher life forms including numerous rotifers and free swimmers. Some lagoons never grow stalked ciliates due to the fact that there is not a lot of biomass for them to attach to. Do not worry what you have or do not have compared to your neighbor's plant. Learn what you have at the optimum time your plant is running the best. Then use that as your benchmark. If the higher life forms shift too young, adjust the nutrients and bacteria. If the higher life forms shift too old, cut back and save costs.

Some things to note in your plant:

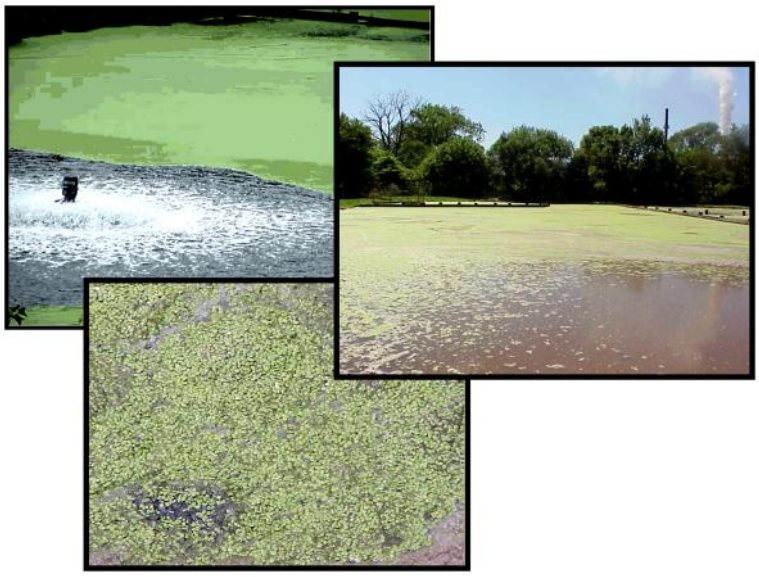
All your higher life forms died- you probably had a spill-
If your D.O. is very high, the spill was probably toxic due to the fact that the bacteria are not consuming any oxygen.
If your D.O. is virtually gone, you have tons of high, white crisp foam, you just got hit with a high BOD loading that is easy to degrade and the bacteria are in a high growth phase. Remember the bacteria achieve 98% of all work done in the lagoon. A common misconception is that just because the higher life forms are gone, the system is dead. See technical training sheet on higher life forms.

The biggest problem with spills, it that many times, a plant then does not go and **"spill" some nutrients** to match the loading and it makes it harder for the bacteria to work on the extra loading. Filamentous problems or zooglea or tetrads often occur when high loading that is easy to degrade are spilled in a plant. Go check you nutrients- the most common problem at a plant. Nutrients can be expensive- many times up to 17% of a budget at a plant. But they are critical, and cannot be skimped on.

Foam is a good indication of what is going on in your plant.

If you have white crisp foam, it means the bugs are in a high growth phase. Ok, so in a lagoon, that means there should be a little bit in the front, not 6-8 feet! Watch also how the foam turns color as it progresses through the system. There should not be foam at the back end of the pond or lagoon. If is present, there is a problem that needs to be addressed.

In a papermill, sometimes the foam looks a bit brown. Check to make sure it does not mean the bacteria are older, but it may mean that your primary is not capturing all the fiber. Did you know



a 1% fiber capture recovery could mean up to a million dollars a year if returned back to the front end? Make sure your primary is doing the job correctly.
See troubleshooting chart on foam and colors. Better capture in the primary also helps with TSS and BOD loading on the pond.

What is all that green stuff on in my pond? Duckweed or algae can oftentimes grow in lagoon systems. Many times it is due to excess un-degraded BOD. Focus on improving the BOD removal efficiency in your system and most often times the duckweed or algae will go away. Very rarely are they due to too many nutrients, as is the common misconception. See handout on Duckweed.

Tetrads or cyanobacteria also oftentimes show up in a lagoon or pond system. Again, due to lack of nutrients and high BOD, most often lack of Nitrogen. These can cause serious problems with TSS, so go check your nutrients.

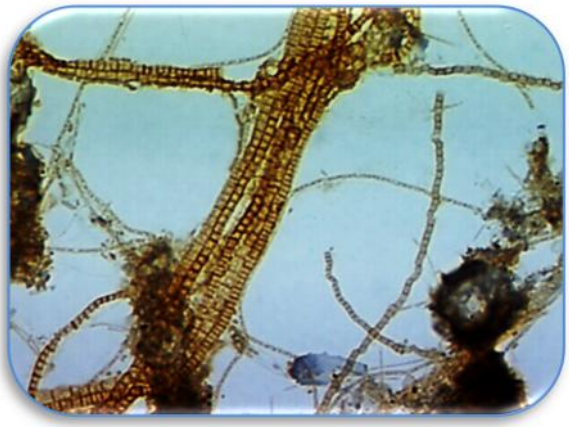
Algae in the final effluent can cause false high BOD readings, so be sure to check what is going on in your system. It can clog up pumps or screens, so make sure to monitor and control carefully.

Another Critical 5 parameter that must be paid attention in is aeration.

It does not really matter what type of equipment you use for aeration, whether it is jet aeration, mixers, diffused air, just as long as you remember the purpose of the aeration device is two-fold. One to provide sufficient oxygen to the bacteria in order to degrade the BOD. The second purpose of aeration equipment is for mixing purposes. Without proper mixing, the bacteria will settle in the wrong spots, cause dead spots and many problems. Make sure you do not have short circuiting also. Many times, just moving a few aerators around can solve both problems.

Many lagoons have dead spots or can be extremely huge and hard to aerate the entire lagoon, especially when a spill of high BOD loading has occurred. A quick and easy trick is to supplement nitrate in the system, especially in the low D.O. spots when mechanical aeration is not possible.
The nitrate can help with odor control and with providing an alternate supply of oxygen to the facultative bacteria, allowing them to degrade the extra BOD without turning anaerobic and generating the associated odors.

Filamentous bacteria often grow in lagoons. A common type found, especially in papermills and food plants are Type 021N. This is often due to holding solids too long in the primary clarifier in papermill cases and nutrient deficiency in food plants and/ or papermills- usually nitrogen.



H. Hydrossis is also common in lagoon environments. Although filaments are very good BOD degraders, they do take up larger volumes of space. Since most lagoons do not have clarifiers, and instead usually require a settling zone for biomass solids. If more filaments than floc are present, solids will build-up quicker and increase the need for dredging sooner. Make sure to control filaments in your lagoon, since the major caused are low D.O and low nutrients in a lagoon, monitor and control these parameters carefully.

The addition of MicroClear® M100 Micronutrients to a lagoon system can significantly help increase biological activity, shorten lag growth time and help with floc formation. Since it is hard to control biomass and F/M ratios in a lagoon, any help that you can give to the bacteria to make their job easier, in the long run helps your plant run more efficiently and achieve better results. Micronutrients are required by most organisms. Research biologists have long known the importance of micronutrients, such as trace minerals, amino acids and vitamins, in the growth and reproduction of healthy cells. Much of this work was pioneered in the agricultural industries of poultry, cattle and pig farming. Under controlled conditions, researchers have been able to develop formulations that provide an optimum micronutrient balance to ensure rapid and healthy growth. Lab and field-testing have shown that micronutrients are critical in the formation of new, healthy cells. By maintaining adequate micronutrient levels, the system should be more resilient to load swings and toxic shocks. Micronutrients are also related to good floc formation. Regular application of micronutrients should improve settleability. Lab and field data also indicate that the application of micronutrients will shorten the "lag phase" and speed the recovery of a system that has experienced a toxic shock or increased loading.

These Trial photographs below are of a Papermill lagoon prior to bioaugmentation is on the lower left, and after bioaugmentation with micronutrient supplements lower right. BOD removal and TSS removal increased significantly as well as lowered filaments.

Contact Environmental Leverage 630-906-9791 or email to admin@EnvironmentalLeverage.com to inquire about a bioaugmentation program at your facility.